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14 October 1965

Please Reference:
A51-65-3380

65.088
2 1 of 5
6 pages

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Subject: [redacted] 675-65WR
Our Sales Order 1-10290-1

Gentlemen:

We are pleased to provide the third in a series of Monthly Progress Reports covering the effort expended on subject contract during the period of September 2, 1965 to October 1, 1965.

Clean Room Installation

The clean room installation final acceptance tests were completed, and the installation accepted as being constructed, installed and functioned in accordance with the specifications forming part of the contract.

Research Program

1. Rotary Air Bearing.
The final report on this program is in preparation.

2. Sensitometric Studies.
In this reporting period an evaluation was made of the rotating wheel sensitometric processor, described in Progress Report #2 for August 1965. Two processing conditions were tested. Anticipating the worse processing conditions the 118°F, 15 Seconds time/temperature combination was selected as the

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starting point, followed by the 68°F 8 minute combination. Five film samples per time/temperature combination (film type 4401) were processed to determine the reproducibility of the wheel processor.

Preliminary investigations revealed the necessity for establishing a proper relationship between the width, and composition of the wheel, the operating rpm, and the volume of solution required to obtain an acceptable level of processing reproducibility.

The optimum relationships were determined as follows:

A cork wheel coated in plastic with a width of 1-1/4-inch set and operated at a speed of 160 rpm, produced a desirable meniscus which could be further controlled by adjusting the volume of the processing solution to a maximum level of 500 ML.

Film type 4401 was cut and exposed into 20 - 16mm x 12-inches strips, and the latent image allowed to stabilize before processing.

The film sample was attached to the cork wheel and lowered into 500 ML of D-19 for 15 seconds at 118°F. Two seconds before the completion of the development cycle, the wheel was raised to its upper position. With the wheel in motion, the stop bath was applied directly to the emulsion by means of a syringe which was mounted over the film sample. The film sample was then processed in the conventional manner. The above processing procedure was performed five times for each time/temperature combination.

Results:

118°F 15 seconds combination:
Gamma difference = 0.08
D min " = 0.01
D max " = *

68°F 8 minutes combination:
Gamma difference = 0.05
D min " = 0.01
D max " = *

*Note: D max readings are not available, since the Welch densitometer available is not capable of reading density units above 3.00 nor is it capable of reading with any accuracy above the 2.85 density level.

cont

Conclusions:

The results of this investigation revealed that the wheel high-temperature sensitometric processor will just meet the requirements necessary to complete this project.

3. Study of Film Drying Techniques.

Program Objective:

To investigate, by mathematical analysis and laboratory research, various methods of drying aerial photographic film and to propose an advanced dryer concept having a film handling capacity of greater than 100 feet per minute and of a smaller physical size than the large units now being used at lower film speeds.

The research investigation of advanced film drying techniques was initiated and a literature survey undertaken to summarize the existing and proposed methods of film drying. An examination of the literature available on film drying indicates that some form of hot air dryer is used almost exclusively. Many variations of hot air drying are described and some mention is given to other methods for drying in the literature studied. The methods available for drying film are:

Heat - Conduction, convection, radiation including high velocity hot air impingement, turbulent air, infra-red heating, drum drying and other variations.

Vacuum - The lowering of vapor pressure to increase the rate of evaporation - the opposite of air blowing over the film - the suction of water vapor from the film surface.

Cold - Use of freeze drying techniques.

Chemical - Solvents to absorb or replace the water by absorption and adsorption.

Mechanical Separation - Roller squeegees, (effective only for surface water removal).

Electrical - Disassociation of the water vapor and carrying away of the components ($H_2 + 0_2$).

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In all the methods in use, the removal of surface water is necessary before actual drying of the film is commenced. This investigation will include a review of current means of surface water removal and elimination of water spots.

Due to the relatively short period of time which has been allotted for this investigation, it will be impossible to study fully all of the various technologies which could be applied to the drying of film. This study will therefore be limited to analytical investigations and laboratory research on the following basic means of drying:

a. Hot air impingement drying (utilizing the HF ABD-4 air bearing dryer).

b. Vacuum or lower than atmosphere pressure chambers.

c. Chemical - solvents and use of ultrasonics to facilitate diffusion.

d. Combinations of heat, cold, vacuum, chemical as the investigations warrant.

The above basic methods or combinations of these methods appear to offer the most fruitful avenues of research.

A basic dryer test set up has been established and is being fabricated. This configuration will allow for the laboratory testing of the maximum number of parameters with the minimum of changes in the testing set up.

It is hoped to use film types 5425, Super XX Aerographic (the thickest emulsion on an acetate base) and 2401, plus X aerographic (the thickest emulsion and gel backing on an Estar base). These types of films will give the maximum water absorption for both gel backed and unbacked films. Raw (unprocessed) film stock will be used for the film drying tests. It has been reported in the literature that the amount of water absorbed in the unprocessed stock is a function of the temperature of the soaking water. Raw film stock will be used to obtain reproducible results since the processing of film for each drying test run is not only expensive and time consuming, but also introduces as many variables as there are chemical and wash baths to control.

Conclusions: To achieve film speeds at greater than 100 fpm with present dryer configurations would be inefficient as regards to cost and size. A more efficient means of drying film appears to be available by methods which combine or extend the basic technologies of drying.

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4. Heat Shock Study.

Concurrent with the design of the basic film-handling apparatus, an intensive survey was undertaken of available proprietary heating elements from which to fabricate the four thermal units. Two sets of 16 elements each were selected (these were manufactured by the [redacted] STAT
STAT [redacted] so that the efficiency of high-voltage low-amperage heating could be compared with low-voltage high-amperage units. The low-voltage units are rated at 225 watts each at 12 VAC and 60 cycles; the high at 500 watts at 120 VAC and 60 cycles. Several heat-resistant plastic materials were obtained from the
STAT [redacted] for potting the elements. While the remainder of the electrical mensuration equipment was enroute (voltmeters, ammeters, variable transformers, switches, etc.), the balance of the film-handling apparatus was in progress as follows.

The design consists basically of a developing tank, short stop, fix and wash. It is planned to take up the film wet and dry the test section only subsequently, as a separate step. Only the stainless steel developing tank (capacity 6-1/2 gallons) had to be fabricated specifically for this project. The remaining tanks, of lucite and P.V.C., were obtained on
STAT loan from [redacted] storage to complete the line up.

Other equipment on loan are the refrigeration unit, heat exchange, thermostatic temperature controller, numerous pumps, piping and temperature sensing and indicating instruments including highly accurate platinum resistance probes. The wooden supporting framework was completed first and given two coats of epoxy chemically-resistant enamel. Eleven other detail drawings were finished and shop fabrication of components is almost complete.

Several Polaroid record photographs are included with this letter to indicate progress on the main frame and auxiliary parts. Completed fabrication and integrity checkout are scheduled for the week of October 25 at which time experimentation should start. It is hoped that the two types of film requested will arrive sufficiently prior to start-up to enable all preliminary exposure experiments to be completed by then. A [redacted] STAT
solid-state electronic bridge is being modified to record temperatures within $0.5^{\circ}F$ and a special xenon flash unit is being adapted to expose the necessary step wedges and resolution targets. Two types of developer, D-76 and D-19, will be used in conjunction with the requested negative and duplicating films to give as wide a range of results as is possible in the allotted time period.

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U. S. Government 6 14 October 1965
A51-65-3380

STAT The funds committed or expended to date are approximately [ ] STAT
exclusive of [ ]

If you should have any questions or desire further information, please do not hesitate to contact us.

Very truly yours,

[ ] STAT

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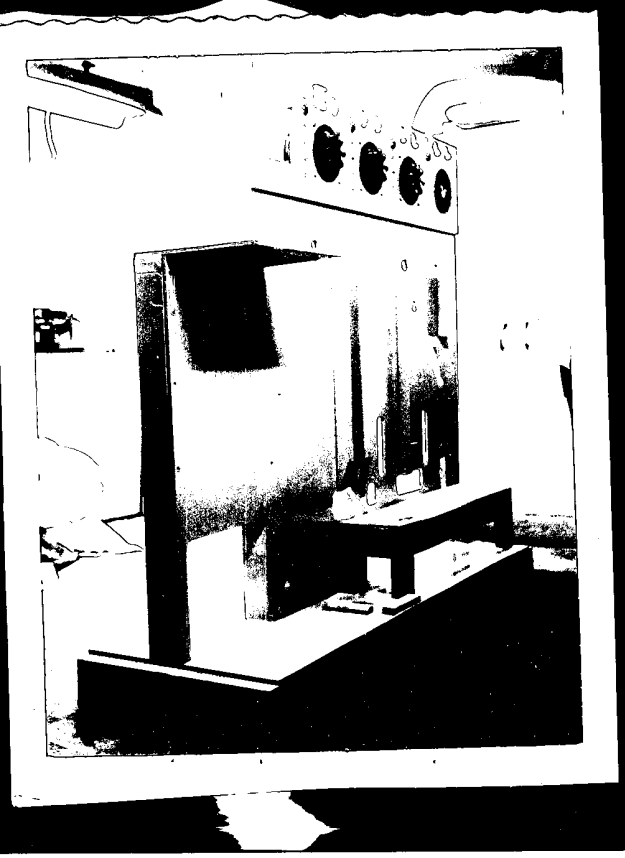
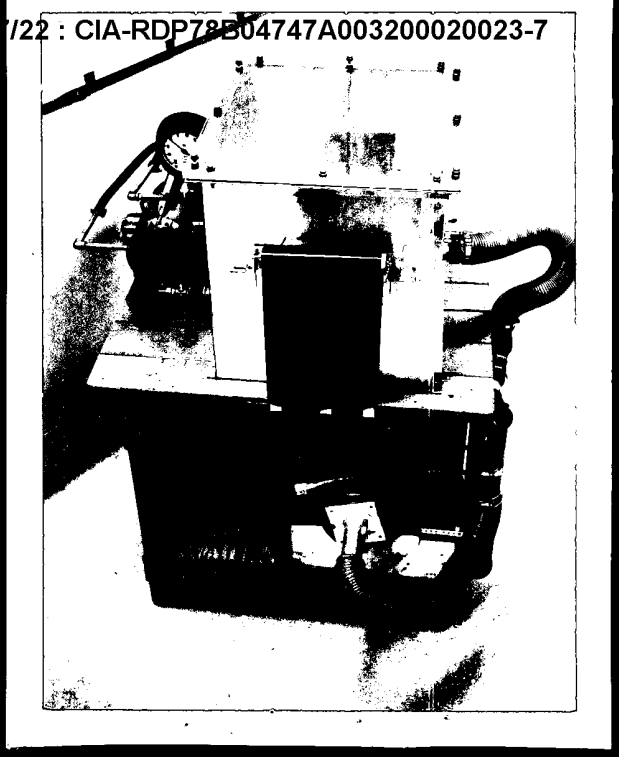
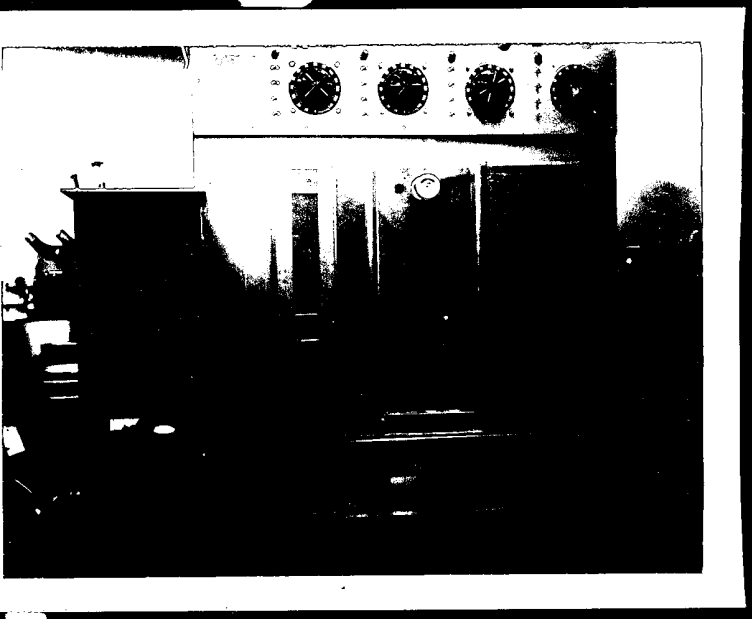
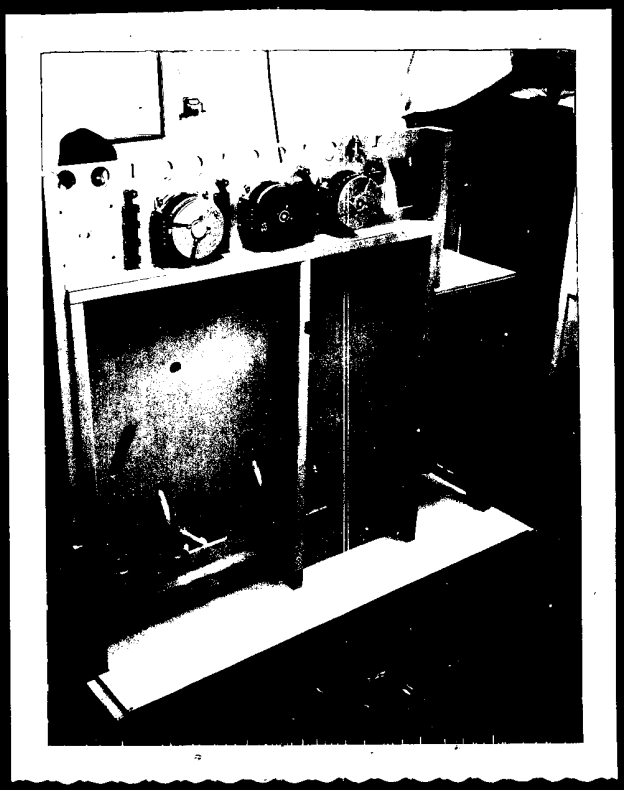
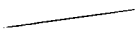








FILM DRYING TEST RIG.



SUPPORTING FRAMEWORK WITH SOME INSTRUMENTS MOUNTED ON PANEL

BACK VIEW OF SUPPORTING FRAMEWORK

FRONT VIEW OF APPARATUS SHOWING POSITION OF 4 TANKS, REFRIGERATION UNIT (LOWER LEFT) AND 4 VARIABLE TRANSFORMERS.

MOUNTING FRAME FOR FOUR LOW-VOLTAGE HEATING ELEMENTS

VARIOUS COMPONENTS (LEFT TO RIGHT):

1- PRESSURE ROLLERS
2- MOUNTING FRAMES (1 WITH ELEMENTS IN PLACE BUT NOT POTTED)
3- 70 m/m TRANSFER ROLLERS
4- SPECIAL BEARING JOURNALS & AXLES